REMARKS

Claims 1-9, 11-21 and 23-26 are pending in the application. Applicants have amended the claims in order to remove the rejections under 35 U.S.C. § 112, 2nd paragraph, and to clarify the present invention.

Claims 1-3, 12-19, 22 and 24 are rejected under 35 U.S.C. § 103(a) as obvious in view of Maehata (JP 62-009822), optionally in view of Saito (JP 8-300227); claims 20-21 are rejected under 35 U.S.C. § 103(a) as obvious over a combination of Maehata and Saito; claims 4, 5, 7 and 16-17 are rejected under 35 U.S.C. § 103(a) as obvious over a combination of Maehata, optionally in view of Saito and further in view of Takahashi (JP 6-210,517); claims 11 and 23 are rejected under 35 U.S.C. § 103(a) as obvious over a combination of Maehata, optionally in view of Saito and further in view of Sakanishi (JP 63-306826); and claims 25 and 26 are rejected under 35 U.S.C. § 103(a) as obvious over a combination of Maehata, optionally in view of Saito and further in view of Magara (JP 10-128,620). Reconsideration and removal of these rejections are respectfully requested on the basis of the present amendment to the claims and the following remarks.

Maehata teaches a metal removal process with the electrolytic current caused in a gap between a rotating electrode and a workpiece, as shown in Fig. 4. The gap is defined by the pressure of an electrically conductive abrasive injected thorough the core of the electrode and the pressure at which the electrode is pressed onto the workpiece. The electrode is rotated to make the pressures uniform.

Mehata not only fails to teach or suggest the claimed feature of carrying out the discharge processing while "pressing the electrode against the processing subject at a predetermined pressure so as to form a thin film of the processing medium between the electrode and the processing subject, the thin film having a predetermined discharge starting voltage," but it also fails to teach or suggest the claimed feature of "moving at least one of the electrode and the processing subject relative to each other."

In the present invention, a voltage is applied to a gap between a non-rotating electrode and a workpiece to cause an intermittent discharge to process or remove a surface of the workpiece (see Fig. 1). The gap is formed as the electrode slides over and floats on an insulating semi-solid viscous processing medium with the relative movement of the disk in relation to the workpiece. The electrodes 1a and 1b in Fig. 5 are also non-rotating in a sense that each does not rotate around its central axis but is shifted relative to the workpiece by the rotating means 24 such that the electrodes float on the processing medium.

On the other hand, Machata relates to an electro-chemical buffing method in which removal of metal via dissolution due to electrolysis is combined with scrape abrasion using abrasive grains as a processing medium, the scrape abrasion assisting the removal. In the Machata method, a voltage is applied between the electrode and the workpiece to process or remove the surface of the workplace through the electrolysis as well as to polish the workpiece through the scrape abrasion by rotating the electrode to press the abrasive grains onto the workpiece. Specifically, the present claimed invention is quite distinct from the Machata reference for the following reasons.

Firstly, while the discharge processing according to the present invention requires an insulative processing medium to cause the discharge, the electrolytic abrasion or grinding as taught by Maehata requires a conductive processing medium to cause the electrolysis. According to Maehata, "a water-permeable insulative abrasive 2"is used (at page 3, top left column, line 13). The abrasive in fact "causes the metal removal by dissolution on the surface of the workpiece 3 with an electrolytic current flowing from the workpiece 3 (anode) through the processing liquid 5 included in the abrasive 2 to the electrode 1 (cathode) (at page 3, top right column, lines 2 to 4). Therefore, the element corresponding to the processing medium of the present invention is the abrasive 2 including the processing liquid 5 and thus the abrasive 2 as a whole is different from the insulative processing medium used in the present invention because the abrasive 2 is conductive.

Secondly, in discharge processing of the present invention, the mechanical scrape abrasion of the workpiece required in Maehata is not necessary. That is, the present invention essentially does not require any mechanical contact between the electrode and the workpiece. In other words, according to Maehata, the abrasive grains are pressed onto and moved relative to the workpiece to carry out the scrape abrasion. The pressing and the relative movement are achieved by placing the abrasive grains between the electrode and the workpiece, pressing the electrode onto the workpiece, and moving (for example rotating) the electrode relatively to the workpiece. Maehata does not teach anything about pressing the electrode against the workplace at a predetermined pressure such that the processing medium is formed into a thin film.

Thirdly, the "thin film" according to the present invention is formed by moving and pressing the electrode and the workpiece relatively to each other. The thickness of the thin film may be set at a predetermined thickness and thus the discharge starting voltage can be decreased in accordance with the thickness. As described in the specification, the discharge processing is carried out while the electrode and the workplace are pressed and moved relatively to each other such that grease 13 is caught between the electrode and the workplace 2 to form a very thin oil film of the grease 13. The thickness of the film can be controlled by changing the contact area between the electrode 1 and the workpiece 2, the pressing pressure, the relative shifting rate, and the viscosity of the grease 13 which are controlled by the control unit in the control device 28. As also described in the specification, at page 22, lines 13 to 20, since the thickness of the film formed between the electrode and the workplace is very thin, for example, 1 micro meter or less, the discharge starting voltage is low, about a few volts to 10 V, or 20 V at highest, in contrast to typical discharging apparatuses requiring the discharging start voltage of 80 to 100 V.

Therefore, a thin film having a predetermined discharge starting voltage can be formed by placing a processing medium between an electrode and a workpiece and shifting and pressing the electrode and the workpiece relatively to each other. As a result, a surface roughness of 0.1 micro meter or less with a gloss can be achieved through the very simple control described above. Moreover, since the electrode 1 is kept floating on the grease film on the workpiece, elements such as a processing vessel, an expensive NC, and a servo mechanism which are required in typical discharge processing apparatuses are not necessary. As a result, the discharge

processing can be carried out inexpensively, stably, and with high precision. Applicants' claims 1 and 13 have been clarified to highlight this feature.

On the other hand, Maehata directed to keeping the gap between the surface of the electrode 1 and the processing surface of the workpiece 3 constant to evenly carry out the abrasion on the processing surface.

Although pressing the electrode onto the workplace at a predetermined pressure and moving them relatively to each other are required in Maehata, there is no motive to utilize these requirements in the discharge processing of the present invention, which fundamentally does not require them.

The further reference to Saito does not teach or suggest the deficiencies in Maethata. Thus, claims 1 and 13 are distinguishable over Maehata in view of Saito.

Further, the Examiner acknowledges in the Office Action that Maehata has no discussion of a "thin film" formed by the processing fluid. The Examiner, however, contends that since a gap to which the processing fluid is supplied is controlled, it is clear that the thickness of the processing fluid therebetween is also controlled. Applicants respectfully disagree.

A review of the Maehata reference shows that the gap or the thickness of the processing fluid referred to in the Office Action between the surface of the electrode 1 and the surface of the work 3 is kept constant. (page 8, lines 17-19 of the full translation) Maehata does not teach or suggest that the thickness of the gap (processing fluid) is controlled. On the contrary, the thickness of the film according to the present invention is controlled such that the thickness can

not only vary but be constant depending on various working conditions. For example, the present specification at page 20, lines 6-10 describes:

> Thus, it becomes possible to change the film thickness according to the surface roughness and the lubricating state required for the processing subject, the power supply specifications, etc.

(emphasis added)

Even if the thickness of the processing fluid in Maehata were controlled to vary, Maehata does not specifically teach how the thickness is controlled. Specifically, claim 1, as now amended, requires that:

> ... controlling a thickness of the film by changing at least one of parameters selected from the group consisting of the contact area between the electrode and the processing subject, the pressing pressure, the relative shifting rate and the viscosity of the processing medium

Similarly, claim 13 requires that:

> ... a control unit which controls the contact area between the electrode and the processing subject, the pressing pressure, the relative shifting rate and the viscosity of the processing medium as parameters, and gives an instruction for changing at least one of the pressing pressure and the relative shifting rate so that a thickness of the film is controlled

Thus, these features are not taught or suggested by Maehata. The further reference to Saito merely discloses an electrode for electric discharge machining which allows for secondary processing without exchanging the electrode even under secondary processing conditions by just changing the electric discharge conditions. The Saito reference also does not teach or suggest that the thickness of the film is controlled. Nor is such a teaching found when the Saito

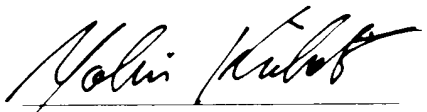
reference is combined with Maehata. Thus, it is respectfully submitted that neither Maehata nor Saito or their combination renders claims 1 and 13, and dependent claims 2-3, 12, 14-19 and 24, which depend from claims 1 and 13, respectively, obvious over these references.

Independent claims 1 and 13 patentably distinguish over the Maehata and Saito for the reasons above. Dependent claims 4, 5, 7, 11, 16, 17, 20, 21, 23, 25 and 26, due to dependency, also patentably distinguish over Maehata and Saito for at least the reasons that their base claims 1 and 13 patentably distinguish over the cited references. The remaining references do not add anything to a combination of Maehata in view of Saito. Therefore, for the same reasons that independent claims 1 and 13 are not obvious over Maehata in view of Saito, dependent claims 4, 5, 7, 11, 16, 17, 20, 21, 23, 25 and 26, which depend from claims 1 and 13, respectively, are not obvious over the combination of Maehata and the other cited references.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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